Idaho Rule 10(j) Proposal, Lolo Zone

SUMMARY: The U.S. Fish and Wildlife Service (USFWS) reintroduced gray wolves to central Idaho in 1995 and 1996 as a Nonessential Experimental Population under Section 10(j) of the Endangered Species Act (ESA). The USFWS is required by the ESA to recover all species on the list. The recovery goals for gray wolf populations was defined as the maintenance of 30 breeding pairs and 300 wolves established across Idaho, Montana, and Wyoming for a period of 3 consecutive years. This objective was met in 2002. The 10(j) rule was amended in 2005 and again in 2008 to allow states increased management flexibility to address wolf depredations on livestock and "unacceptable impacts" on wild ungulate populations. Wolf delisting and regulated hunting is the preferred population management strategy for the Idaho Department of Fish and Game (IDFG). However, delisting of the biologically recovered wolf population has been delayed by litigants and the courts. This proposal is a near-term measure consistent with Rule 10(j) to relieve unacceptable impacts on a population of elk IDFG believes will continue to decline without intervention. Data presented herein demonstrate that elk populations in the Lolo Elk Management Zone (Lolo Zone) are far below historic levels and current population management objectives. The data further demonstrate that wolf predation is a primary cause of mortality and is preventing the cow elk component of the population from reaching management objectives. Based on survival data and computer modeling, the Lolo Zone elk population is expected to continue to decline at a rate of 14to 16% annually.

IDFG has worked diligently with cooperators to improve habitat conditions through fire and logging in this area, along with decreasing the number of other predators (black bears and mountain lions) through increased harvest. IDFG also reduced elk hunters by 83% and eliminated cow elk harvest. IDFG proposes to manage for a minimum of 20 to 30 wolves in the Lolo Zone for a period of 5 years. Managing for this level requires an initial minimum removal of 40 to 50 wolves with smaller levels of removal in subsequent years. Previous work on wolf removal indicates that removal of less than 35% of a wolf population may have no detectable effect on wolf abundance, and that removal of 50-80% annually may be necessary to stabilize or decrease wolf populations due to robust birth and dispersal capabilities. Elk populations and wolf populations will be closely monitored throughout the project through radio telemetry, aerial counts, and ground observations.

This effort is warranted due to unacceptable impacts of predation by a biologically recovered wolf population to adult female and calf elk survival, which is preventing the population from increasing to achieve management objectives. This localized removal action is proposed for one of 29 elk management zones in the state and will not reduce the wolf population in Idaho below the Section 10(j) required minimum of 20 breeding pairs or 200 wolves. Of 49 breeding pairs of wolves documented in Idaho at the end of 2009, > 40 breeding pairs occur outside the proposal area, as do > 750 of the minimum number of 835 wolves estimated alive in Idaho at the end of 2009.

INTRODUCTION

Gray wolves (*Canis lupus)* were listed in Idaho as an experimental nonessential population under Section 10(j) of the Endangered Species Act (ESA) when they were reintroduced into Idaho and Yellowstone National Park in 1995 and 1996. By 2002, wolves had reached recovery levels of 30 breeding pairs well distributed among Idaho, Montana, and Wyoming for 3 consecutive years. Prior to delisting, Idaho and Montana developed management plans and enacted laws that provided adequate regulatory mechanisms that would assure long-term survival of wolves. Because delisting may be delayed for an indefinite amount of time, the United States Fish and Wildlife Service (USFWS), in cooperation with Idaho and Montana, developed a new rule under Section 10(j) that provided new guidelines and allowed for management authorities to be transferred to states under a cooperative agreement with the USFWS or Memorandum of Agreement with Department of Interior to states with approved management plans. The new 10(j) rule was adopted by the USFWS in February 2005 (*Endangered and Threatened Wildlife and Plants; Regulation for Nonessential Experimental Populations of the Western Distinct Population Segment of the Gray Wolf* [50 CFR Part 17.84]). The 10(j) rule was further modified in January 2008.

Although the provisions of the new 10(j) rule fell short of allowing the states' preferred management tool of regulated hunting, under Section (v): "*If gray wolf predation is having an unacceptable impact on wild ungulate populations (deer, elk, moose, bighorn sheep, mountain goats, antelope, or bison) as determined by the respective State and Tribe (on reservations), the State or Tribe may lethally remove wolves in question.*" Under the January 2008 rule, unacceptable impact is defined as *"Impact to a wild ungulate population or herd where a State or Tribe has determined that wolves are one of the major causes of the population or herd not meeting established State or Tribal population or herd management goals."* The 2008 10(j) rule listed the following elements that must be described in any removal proposal: 1) the basis of ungulate population or herd management objectives; 2) what data indicate that the ungulate herd is below management objectives; 3) what data indicate that wolves are a major cause of the unacceptable impact to the ungulate population; 4) why wolf removal is a warranted solution to help restore the ungulate herd to management objectives; 5) the level and duration of wolf removal being proposed; 6) how ungulate population response to wolf removal will be measured and control actions adjusted for effectiveness; and 7) demonstration that attempts were and are being made to address other identified major causes of ungulate herd or population declines or of State or Tribal government commitment to implement possible remedies or conservation measures in addition to wolf removal.

The Idaho Department of Fish and Game (IDFG) reviewed statewide elk data to determine if elk populations were below management objectives. Included among the zones below elk management objectives was the Lolo Zone that includes Game Management Units (GMU's) 10 and 12 (Figure 1). This proposal reviews evidence that wolf predation is a major mortality cause preventing the Lolo Zone elk population from increasing and reaching IDFG population management objectives. Additionally, this proposal identifies ongoing efforts to reduce adverse impacts of other factors influencing the Lolo Zone elk population, and identifies approaches to monitor the effects of lethal wolf removal. This proposal provides the analysis that sets the stage for wolf removal under Section 10(j) as an alternative to regulated hunting.

SECTION 10(j) REMOVAL PROPOSAL CRITERIA

1) The basis of ungulate population or herd management objectives.

The management objectives for elk in the Lolo Zone (GMUs 10 and 12) are to maintain an elk population consisting of 6,100 – 9,100 cow elk and 1,300 – 1,900 bull elk (Kuck 1999). Individual GMU objectives for the Lolo Zone are: 4,200 – 6,200 cow elk and 900 – 1,300 bull elk in GMU 10; and 1,900 – 2,900 cow elk and 400 – 600 bull elk in GMU 12 (Kuck 1999).

The cow and bull elk abundance objectives were established in the current elk plan finalized in 1999. At that time, the most recent survey information indicated cow elk abundance was within the objective range in GMU 10, while GMU 10 bull abundance was below objectives (Table 1). Both cow and bull elk met objectives in GMU 12 (Table 2). Overall, Lolo Zone cow abundance met objectives while bull abundance was below objectives in 1999.

The cow and bull elk abundance objectives were established to allow growth of the population over time. Beginning in 1998, rifle season antlerless harvest was closed and rifle season bull harvest participation was limited to 1,600 hunters (see section #7). IDFG biologists anticipated that those restrictions would allow growth of bull and cow abundance, ultimately allowing the bull elk population to reach objectives.

The elk abundance objectives were set to levels that could be sustained by habitat within the Lolo Zone. At its peak in 1989, the Lolo Zone elk population was estimated to number 16,054 elk (IDFG, unpublished data). Elk calf recruitment rates at that time ranged from 25 to 31 calves:100 cows (IDFG, unpublished data), while cow elk survival was estimated at 0.886 (SE = 0.094) (Unsworth et al. 1993). Those vital rates were sufficient to support moderate population growth, despite sustained annual cow elk harvest. Informal assessment of forage utilization suggested that the elk population had not exceeded or even reached habitat potential at that time.

Beginning in 1992, recruitment rates dropped to levels at or below 20 calves:100 cows, and low recruitment has been chronic since then (Tables 1, 2). Low recruitment and severe conditions during the winter of 1996-97 caused a substantial decline in elk abundance. Among various competing hypotheses, biologists speculated that the recruitment decline might be a density dependent response caused by the elk population growing near habitat potential in the late 1980s. Consequently, the population objective range was established below the peak of 16,054 elk to address that possibility. The maximum population size at the upper end of the objective ranges, and assuming the presence of 30 calves:100 cows, would be 13,730 elk. The minimum objective population with 30 calves:100 cows would be 9,230 which is 57% of the peak population estimated in 1989. Despite the substantial abundance decline in the Lolo Zone, calf recruitment failed to respond in a density dependent fashion, but rather, recruitment responded in an inverse density dependent or density independent manner to declining abundance in the Lolo Zone (see section #3), a pattern common to other Idaho elk populations (Pauley 2007). Pauley (2007) examined recruitment trends in Idaho elk populations following harvest-caused population declines and population declines caused by low recruitment. Following recruitment-caused abundance declines (mean = -50%), recruitment rates declined further from a mean of 26 calves:100 cows to 18:100 (t = 4.90, P = 0.004). Following harvest-caused population declines (mean = -40%), recruitment rates declined from a mean of 37 calves:100 cows to 29:100 (t = 4.99, P < 0.001). Furthermore, recruitment rates remained low and failed to return to pre-decline levels for 6 years. Those results implied an inverse density dependent relationship (recruitment declines with declining density) that could not be explained by time lags extending to 6 years. Additionally, Pauley (2007) determined the presence of inverse density dependence could not be explained by adult cow senescence, similar to the findings of Hamlin and Cunningham (2009). Declining recruitment was strongly associated with increasing mountain lion harvests and wolf abundance in Idaho (r^2 = 0.64, F = 54.58, P < 0.001) (Pauley 2007). Pauley (2007) concluded that Idaho elk populations might largely exist below habitat potential where inverse density dependent effects of predation might overwhelm density dependent responses to resource limitations. Similarly, Lubow et al. (2002) detected density dependence in Rocky Mountain National Park when the elk population was near hypothesized carrying capacity, but did not detect a similar response in a subpopulation outside the park that was at approximately 70% of hypothesized carrying capacity. White and Garrott (2005) failed to detect density dependence in the Northern Yellowstone elk herd and suggested the population never reached carrying capacity.

It could be argued that given habitat succession, habitat potential may have declined more rapidly than elk abundance, and thus, habitat potential might be below the level necessary to sustain the elk population at objectives in the Lolo Zone. Given the rate of succession (USDA 1999), it is inconceivable that habitat potential might decline at such an aggressive rate.

The decline in Lolo Zone recruitment rates at the peak of elk abundance is the single thread of evidence that might suggest Lolo Zone elk were limited by habitat potential. Between 1997-2004, White et al. (2010) determined that low recruitment was a function of high calf mortality that was caused by black bear and mountain lion predation. If habitat limitation was responsible, those losses would be largely compensatory (e.g., the calves would be predisposed to death). Alternatively, if habitat limitation was not an issue, the losses would be largely additive (e.g., calves would otherwise survive if not killed by predators). White et al. (2010) manipulated mountain lion and black bear abundance in an experimental framework which led to corresponding changes in calf mortality and survival, demonstrating additivity in predator caused calf mortality. Those findings do not rule out the possibility that habitat limitations played some limited role because low birth weight of calves, which is linked to resource limitations, also influenced survival. However, the additive affect of bear predation and the measured effects of bear harvest on calf survival indicated that bear densities had the greatest influence on the range of calf survival. These findings reject the hypothesis that habitat limitation was solely responsible for low calf recruitment and the elk decline (White et al. 2010). Furthermore, even if habitat limitations played some role in diminished recruitment at maximum density, those limitations would not affect the population at objective levels, given density dependent processes.

IDFG recognizes that it would be useful to determine carry capacity in the Lolo Zone. While the concept of carrying capacity is theoretically appealing, reliable, validated estimates of elk carrying capacity remain elusive. The Northern Yellowstone elk herd is the most studied elk population in North America, and it was hypothesized that the population reached carrying capacity during the 1980s and early 1990s when growth slowed and recruitment declined (Singer et al. 1997). However, the population failed to exhibit density dependent responses to the subsequent population decline casting doubt on that conclusion (White and Garrott 2005). Lacking any reliable means to accurately estimate carrying capacity, it is necessary to evaluate available evidence and to determine appropriate population objective levels that are judged to be below carrying capacity. Existing evidence, although not conclusive, strongly suggests that abundance objectives are well below carrying capacity in the Lolo Zone.

2) What data indicate that the ungulate herd is below management objectives.

IDFG biologists use aerial surveys and the sightability method (Samuel et al. 1987, Unsworth et al. 1994) to monitor elk populations throughout the state, including the Lolo Zone (hereafter referred to as "sightability survey"). The sightability survey approach includes a statistically and biologically sound sampling framework along with a validated method to correct for visibility bias. Surveys are conducted on a 3-5 year rotation and are flown during winter when animals are concentrated on winter range. Biologists generate estimates (and confidence intervals) of population size, age ratios (e.g., calves:100 cows) and sex ratios (e.g., bulls:100 cows) from the survey data. Age composition surveys were conducted during some years in the Lolo Zone. Protocols for composition surveys are identical to those for complete aerial surveys, except that sampling intensity is greatly reduced. Composition surveys provide useful age ratio data, but they do not provide the data needed for abundance or sex ratio estimates.

The 2010 survey data revealed that bull and cow elk abundance were both well below objectives in GMU 10 (Table 1). The estimate of 469 bulls was well below the objective range of 900 – 1,300 bull elk. Similarly, estimated cow abundance (824) was well below the objective range of 4,200 – 6,200 cow elk.

Bull and cow elk were well below objectives in GMU 12 in 2010 (Table 2). The estimate of 133 bull elk was well below the objective range (400-600 bull elk), while the estimated 539 cow elk was well below the objective range (1,900 – 2,900 cow elk).

For the entire Lolo Zone, the 2010 sightability survey revealed 1,358 cow elk (90% Bound = 1,061 – 1,655), and 594 bull elk (90% bound = 443 – 745). The zone-wide objectives are 6,100 – 9,100 cow elk and 1,300 – 1,900 bull elk. Thus, within the Lolo Zone as a whole, bull elk and cow elk were below objectives in 2010.

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3) What data indicate that wolves are a major cause of the unacceptable impact to the ungulate population.

<u>Historic Elk Demographics</u>

Elk calf recruitment, from birth to mid-winter, declined in the Lolo Zone from levels ranging from 25 to 31 calves:100 cows in the late 1980s (IDFG unpublished data), to unusually low levels in the 1990s (Tables 1, 2). Calf recruitment is indexed by calf:cow ratios determined during mid-winter surveys. Depending on cow elk survival rates (typically 0.88-0.90), and calf survival following the surveys, mid-winter recruitment of at least 20 to 25 calves:100 cows is typically necessary to sustain population stability, in the absence of hunting losses.

In 1997, IDFG research staff initiated an investigation focused on calf survival and cause-specific mortality early in life. Newborn elk calves were radio-collared and monitored annually from 1997 through 2001, and during 2004 and 2005 in GMU's 10, 12, and 15. In GMU's 10 and 12, black bears and mountain lions caused the majority of elk calf mortality, accounting for 43% and 42% of the losses, respectively. Of the 101 deaths of newborn, radio-collared calves in that study, only 2 were attributed to wolf predation. Subsequently, mountain lion and black bear populations were manipulated with changes in harvest levels brought about by hunting season changes and the cooperation of commercial outfitters. The manipulations were implemented in an experimental framework to measure the additivity of black bear and mountain lion predation (White et al. 2010). A portion of GMU 10 served as a control area while a portion of GMU 12 served as a treatment area. The treatment consisted of increased black bear and mountain lion harvest. Elk calf survival rates increased as black bear and mountain lion removal increased (White et al. 2010). The aggressive hunting season frameworks were maintained in the Lolo Zone at the conclusion of the research effort to maintain high black bear and mountain lion harvests with the objective of improving elk calf recruitment (see Section #7).

Low recruitment generally led to a gradual decline of the Lolo Zone elk population, while severe conditions during the 1996-97 winter caused further declines. By 2002-03, the Lolo Zone population numbered 4,691 elk, which was well below the peak of 16,054 elk in 1989. Few wolves were present in the zone prior to 2002-03, and wolf-caused mortality of neonatal elk was a minor issue. Wolf predation did not play a significant role in the historic decline of the Lolo Zone elk herd. The previous investigation was conducted while wolves were becoming established in the zone and current research reveals that wolf-caused mortality is more substantial at present wolf densities.

<u>Current Demographics</u>

During December 2005 and 2006, and January 2009 and 2010, IDFG research staff captured and radio-collared 11-30 calf elk each year to measure survival rates from winter, when recruitment is measured during aerial surveys, to June 1, when calves are fully "recruited" into the adult population. This investigation was intended to complement the previous work which focused on survival prior to winter. Calf elk of both sexes were captured, radio-collared and monitored for survival status through June 1 of the following year. Dead radio-collared calves were investigated to establish the cause of death using techniques reported by Hamlin et al. (1984). Winter calf survival (Pollock et al. 1989) varied from 0.09 to 0.73 (Table 3).   Wolf predation was the primary cause of death accounting for 21 of 30 (70%) deaths when cause could be established (Table 4).

Cow elk survival was monitored during research efforts in the Lolo Zone beginning in 2002, using the same approach (Table 3). During 8 years spanning 2002-2009, cow survival (Pollock et al. 1989) varied from 0.71 to 0.89 (Table 3).   Wolf-caused mortality increased over the 8-year time frame. Wolf caused mortality was not detected during 2002 or 2003. Two deaths were attributed to wolf predation during 2004, while 35 deaths were wolf caused during 2005-2009

(Table 4). Survival appeared to decline from 2002 to 2009 as wolf-caused mortality increased (Tables 3, 4). During 2005-2009 92% of known-cause deaths (46 of 50) were due to predation, of which 80% (37 of 46) were caused by wolves (Table 4).

These data imply that hunting losses are not a significant factor in Lolo Zone cow or calf survival. Antlerless rifle hunting was closed beginning in 1998. Since that time, legal cow harvest by non-tribal hunters is limited to archery harvests that varied between 0 and 20 antlerless elk/year (Compton 2007), which were not detected within the radio-collared sample of elk. The antlerless component of the archery season was closed in 2006. There are also likely losses to illegal human harvest and legal harvest by Nez Perce tribal members that likewise are of insufficient magnitude to be detected in the radio-collared sample.

Lolo Zone cow and calf elk survival rates are inadequate to sustain growth or stability of the cow elk population. Survival is inadequate for cow abundance to reach management objectives. Elk population growth rates are sensitive to adult cow survival and populations that are stable or increasing typically exhibit cow survival rates >90% (Eberhardt 1985). Furthermore, low calf survival likely contributes substantially to population decline (Raithel et al. 2005).

To illustrate the effect of cow and calf survival on the Lolo zone population, we constructed a deterministic, birth-pulse model of the cow segment of the population. The model was structured with years beginning during mid-winter, at the time of surveys. We assumed that recruitment to mid-winter was stable at 23 calves:100 cows, which was the mean level observed during the 2006 and 2010 surveys (Tables 1, 2). This assumption may be overly optimistic given that mid-winter recruitment was often below that level during recent years (Tables 1, 2). We also assumed a 50:50 calf sex ratio, 0.78 cow survival (2005-2009 mean), and 0.54 calf survival from mid-winter to June 1 (2005-2009 mean). We optimistically assumed that survival of those recruited calves (yearlings) from June 1 to mid-winter was 1.0. The model revealed a finite rate of increase = 0.84. We conducted a second simulation with cow survival at 0.80, which was the 2002-2009 mean (Table 3). That model revealed a finite rate of increase = 0.86. Thus, under current conditions, and rather optimistic assumptions, Lolo zone cow abundance is projected to decline at a rate of 14 to 16% annually (i.e., a growth rate of -14% to -16% per year).

The sightability survey point estimates suggest the Lolo Zone cow population declined substantially during 2002/03-2010 (Tables 1, 2). Combining GMU's 10 and 12 reveals a 2002-03 cow abundance estimate of 3,112 (90% bound = 2,700 – 3,524) and a 2010 cow abundance estimate of 1,358 (90% bound = 1,061 – 1,655). Using the point estimates only, these results suggest a finite rate of increase of 0.88 – 0.89 for the period 2002/03-2010, while the model prediction suggests a finite rate of increase of 0.84 – 0.86.

We conducted an additional simulation with survival rates that reflected an absence of wolf-caused mortality. We recognize that implementation of this proposal will not eliminate wolf-caused mortality and merely conducted this modeling exercise to display the potential effect of wolf predation. Given that predation was responsible for 92% of cow deaths, and wolf predation was implicated in 80% of predator caused deaths (see previous discussion), the proportion of deaths caused by wolves would be approximately 0.74. We adjusted survival from 0.78 to 0.94, by adjusting the mortality rate to 0.06, which is the product of the proportion of mortality that was not wolf caused (0.26) and the mean mortality rate with all sources of mortality (0.22).

Given that wolves caused 70% of calf elk deaths from mid-winter to June 1, we likewise adjusted calf survival from 0.54 to 0.86 using the same approach. The model revealed a finite rate of increase = 1.04, implying cow abundance would increase by 4% annually in the absence of wolf-caused mortality, assuming that wolf mortality is entirely additive.

An additional, important assumption relative to wolf predation is the degree to which wolf-caused mortality is additive or compensatory. The impact of predation is greater when mortality due to predation is additive to other types of mortality, and less when deaths due to a predator are compensated by reductions in other types of mortality, or increases in recruitment (McCullough 1979). Experimental manipulation is necessary for conclusive evidence of additivity (Boutin 1992). Nonetheless, some conclusions are possible in the absence of experimental evidence. Wolves have a demonstrated tendency to select older, less thrifty, or young (calves) prey (Carbyn 1983, Boyd 1994, Kunkel et al. 1999, Husseman et al. 2003, Smith et al. 2004, Wright et al. 2006). This tendency implies a compensatory element to wolf predation, and some have suggested that given this tendency, wolf predation may be largely or even entirely compensatory. However, it is unlikely that wolf predation is entirely compensatory at every population level under all circumstances. It is likely that disadvantaged prey have the tendency to be first killed; though it is clear that healthy prey are also killed (Carbyn 1983, Kunkel et al. 1999).

Evidence from other wolf-elk systems provides some insight into additive mortality. In systems without wolves, cow elk survival rates, in the absence of hunting mortality, are typically in the range of 0.90 or higher (White 1985, Freddy 1987, Leptich and Zager 1991, Unsworth et al. 1993, McCorquodale et al. 2003, White and Garrott 2005). With the addition of wolf predation, adult cow survival rates are often much lower (Kunkel and Pletscher 1999, Hamlin and Cunningham 2009, White and Garrott 2005). Annual survival of prime-aged cow elk declined from 0.99 to 0.84 in the northern Yellowstone elk herd with the establishment of wolves in the park (White and Garrott 2005). Although increased human harvests played a large role in lower survival, White and Garrot (2005) attributed much of the reduction in survival to additive effects of wolf predation. Jaffe (2001) found that wolf predation on elk calves limited calf recruitment. Additionally, 56% of adult elk killed by wolves were prime-age, implying an additive effect (Jaffe 2001). Evidence also suggested elk population growth was limited by wolf predation in the Glacier National Park area (Kunkel and Pletscher 1999). Likewise, wolf predation limited elk population growth in Banff National Park, Alberta (Hebblewhite et al. 2002). Hamlin and Cunningham's (2009) synthesis of data sets from across the Greater Yellowstone Area suggests some elk populations are limited by wolf predation.

It is unlikely that the Lolo Zone elk population is currently limited by a density-dependent response to habitat (also see section #1). The abundance of elk estimated during the 2010 aerial survey (2,178 elk) is well below the maximum abundance estimated during 1989 (16,054 elk, IDFG unpublished data). While the Lolo Zone elk population declined sharply from the peak in the 1989 to the 1997-1998 estimate of 7,746 elk, the estimated calf recruitment rate also declined sharply from 28.6 to 6.6 calves:100 cows (Tables 1, 2; IDFG, unpublished data). Thus, estimated density declined by 53% while estimated recruitment declined by 77%. Such strong *inverse* density dependence, or at a minimum, density independence, casts serious doubt on the prospect that the Lolo Zone elk population is limited by density dependent mechanisms. Pauley (2007) revealed a similar pattern of inverse density dependence in other Idaho elk populations. White and Garrott (2005) failed to detect a density effect on recruitment in the Northern

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Yellowstone elk herd. They suggested that the Northern Yellowstone herd did not reach carrying capacity and questioned the conclusions of others in that regard. It could be argued that the apparent inverse density dependence might be a function of irruptive dynamics with lag effects. However, Pauley (2007) found that inverse density dependent effects persisted for up to 6 years in Idaho elk populations and questioned the likelihood of lag effects of that magnitude that might persist beyond that timeframe.

Data on elk body condition in the Lolo Zone suggests that nutrition is not limiting elk population performance. Some evidence of significant malnutrition would be expected if elk populations were limited by food quantity (density dependence) or quality (independent of density). IDFG measured body condition score via palpation and ultrasonography on adult cow elk in GMU 10 during December 2005, January 2009, and January 2010 following Cook et al. (2001*a*, *b*). We found mean body fat composition levels of 12.8% (SE = 2.90, n = 19) in 2005, 11.7% (SE = 3.70, n = 10) in 2009, and 12.6% in 2010 (SE=4.03, n=12). Evaluating the implications of these body fat levels is hampered by the lack of other published data for free-ranging elk measured during December and January with demonstrably adequate/inadequate nutrition. However, research with captive elk suggests that the observed body fat composition levels would not likely be associated with deaths or reduced productivity from malnutrition (Cook et al. 2004). Additionally, there was little evidence of malnutrition among wolf-killed elk. Of the 37 adult cow elk killed by wolves (Table 4), malnutrition was identified as a potential predisposing factor in only 4 deaths. Of the 21 calf elk killed by wolves, malnutrition was identified as a potential predisposing factor in one death.

The effects of resource limitations might be detected in data on elk pregnancy rates. Pregnancy was determined for 112 adult (≥ 2 years age) cow elk captured during 2002-10. The mean pregnancy rate across all years and areas was 0.84. Ages are not available for most of the sample and pregnancy rates vary substantially among adult age classes (Raithel et al. 2005), precluding any meaningful judgments about pregnancy rates in the population.

Research in Yellowstone National Park revealed that wolves tend to prey on older cows (Smith et al. 2004) that have lower survival rates (Raithel et al. 2005), lower fecundity (Raithel et al. 2005), and consequently, lower reproductive value (Wright et al. 2006) than prime-aged cow elk, suggesting an element of compensation. Of the 28 cow elk killed by wolves in the Lolo zone during 2005-2007, year-specific ages were available for 13 cows. The ages were determined either from tooth cementum analysis (Hamlin et al. 2000) or via tooth replacement of elk captured as calves (Quimby and Gaab 1957). The mean age at death of those cow elk was 8.1 years. Eight were prime-aged (≤9 years) and 5 were older cow elk (≥ 10 years). Although inference is very limited by the small sample, it is apparent that wolves were not exclusively preying on older elk.

Survival and cause-specific mortality estimates reveal an additive component of wolf predation in GMU 12. Before wolf reintroduction, Unsworth et al. (1993) estimated annual adult cow elk survival at 0.89. Two of 5 deaths observed by Unsworth et al. (1993) were human-caused (tribal harvest). After wolf reintroduction, annual cow elk survival declined to much lower levels without the occurrence of human-caused mortality among radio-collared elk. Across GMU's 10 and 12, the mean survival during 2002-2009 was 0.80, and survival appears to decline with increasing wolf-caused mortality, 2002 to 2009 (Table 3). Although inference from this comparison is very limited, reduced survival with the addition of wolf-caused mortality would demonstrate an additive effect.

Summary

The Lolo Zone elk population peaked in 1989 and subsequently declined sharply due to low calf recruitment and substantial mortality during the winter of 1996-97. Research findings from 1997-2004 revealed low calf recruitment was a function of low calf survival and further revealed that the additive effects of black bear predation and substantial mountain lion predation were largely responsible for the calf mortality, with some influence from low birth weight. This decline occurred prior to widespread wolf colonization and wolves played a very minor role in neonatal calf mortality throughout the research effort (1997-2004). Wolf predation did not contribute significantly to the early decline. Subsequent efforts from 2002 to the present to measure adult cow elk mortality and older calf mortality between mid-December and June 1 revealed high mortality rates, largely caused by wolf predation. Those efforts occurred once wolves became well established in the zone. Neonatal mortality and survival have not been measured since wolves have become well established and consequently, the role of wolf predation in current neonatal survival is questionable. Wolf-caused mortality of adult cow elk increased during the investigation (2002-2009) while survival rates declined. Given the demographic circumstances, the reproductive portion of the population (cow elk) will continue to decline, and, consequently, will not reach the Lolo Zone cow elk abundance objectives. Wolf-caused mortality is the major factor limiting growth of cow elk abundance, and achievement of State objectives.

4) Why wolf removal is a warranted solution to help restore the ungulate herd to management objectives.

Based on the evaluation and analysis of available data, the State of Idaho determines wolf predation is having an unacceptable impact on the Lolo Zone elk population. Given low cow and calf elk survival rates, cow abundance is expected to decline. Cow abundance is well below State objectives and will continue to decline further below objectives unless those circumstances are remedied. Evidence demonstrates wolf-caused mortality is substantially additive and largely responsible for low cow and calf survival rates. Wolves are one of the major causes, if not the major cause, of the *current* population decline, and consequently, wolf predation is preventing cow elk abundance from reaching objectives. The State of Idaho has implemented extensive conservation measures in an effort to address other factors that might influence growth rates of the Lolo Zone elk population (see Section 7). However, wolf removal is an additional necessary measure to restore cow elk abundance to management objectives. The State of Idaho has determined that wolf removal is warranted as allowed under the 10(j) rule.

5) The level and duration of wolf removal being proposed.

Removal rates of 30-35% or less typically do not cause any long-term changes in wolf abundance, while removals of 40% or more may cause long-term reductions (Gasaway et al. 1983, Keith 1983, Peterson et al. 1984, Peterson and Page 1988). However, wolf populations

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have sustained human-caused mortality rates of 30 to 50% without experiencing declines in abundance (Keith 1983, Fuller et al. 2003). Gasaway et al. (1983) found wolf abundance was unchanged with 16-24% harvest, but declined 20-25% after harvests of 42-61%. Based on mean pack size of 8, mean litter size of 5, and 38% pups in packs, Boertje and Stephenson (1992) suggested 42% of juveniles and 36% of adults must be removed annually to achieve population stability. In their analysis of multiple data sets, Adams et al. (2008) found human caused mortality rates $\leq$29% did not cause wolf population declines. Wolf populations tend to compensate for low removal rates and return to pre-removal levels rapidly, potentially within a year. It is hypothesized that compensatory mechanisms include increased survival, immigration, and possibly increased fecundity (Keith 1974, Seal et al. 1975, VanBallenberghe and Mech 1975, Fuller 1989). However, Adams et al. (2008) found compensatory survival and fecundity shifts were of insufficient magnitude to influence demographics, and that shifts in immigration and emigration rates served as the primary compensatory mechanisms.

Once removals end, the wolf population would be expected to return to pre-removal levels rapidly (National Research Council 1997:Table 3.1). For example, in east-central Alaska, wolf abundance returned to pre-control levels in 3 years following 7 years of control that reduced the population 55-80% (Gasaway et al. 1983). Wolf population growth rates vary widely which is a function of survival rates, immigration, and indirectly, prey abundance (Fuller 1989). Population growth on the order of 50% per year is possible (Hayes 1995). Growth rates are typically high following control efforts owing to the increased per capita supply of prey (Fritts and Mech 1981, Keith 1983, Ballard et al. 1987). Consequently, once a wolf population is reduced to a desired level, it is necessary to remove wolves during subsequent years to maintain reduced wolf abundance.

In Alaska and various provinces in Canada, wolf populations have been experimentally reduced to improve ungulate population performance (National Research Council 1997). The results of those efforts are instructive and provide the foundation for this proposal. In 3 instances, wolves were reduced annually to 49-85% of pre-control levels for periods of 5 to 7 years in Aishihik, Yukon (Hayes et al. 2003). Those efforts revealed the potential to dramatically improve ungulate population performance. However, other wolf control efforts yielded equivocal results. Reducing wolf numbers by more than 60% for 5 years and liberalizing brown bear (*Ursus arctos*) harvest regulations failed to produce a meaningful improvement in moose population performance in southwest Yukon (National Research Council 1997). It was concluded that larger wolf removals over a longer timeframe or the addition of bear removal were needed to increase moose abundance. Similarly, wolves and black bears were removed from separate, small treatment areas in Quebec, with unclear results. Between 33 and 62% of wolves were removed annually. The lack of a response in the moose population was attributed to low removal rates, failure to remove bears and wolves on the same area, and immigration of bears and wolves into small treatment areas during control efforts. In east-central Alaska, wolves were reduced by 28-58% over a 3-year timeframe, with no measurable effect on moose calf survival (Gasaway et al. 1992). Bear populations were not manipulated. Black bear predation was an important source of calf mortality (52%) on the evaluation area and other work implied that brown bear predation was an important source of adult and calf moose mortality (Boertje et al. 1988). Gasaway et al. (1992) concluded that wolf and bear predation limited moose populations below carrying capacity.

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IDFG proposes an adaptive strategy to reduce the wolf population in the Lolo Zone. Wolves will be removed to manage for a minimum of 20 to 30 wolves in 3 to 5 packs. The level of removal will be dependent on pre-treatment wolf abundance. Using the minimum estimated number of 76 wolves in the Lolo Zone at the end of 2009 (Mack et al. 2010), a minimum of 40 to 50 wolves would be lethally removed during the first year. Removal during subsequent years would be lower, but variable, depending on wolf abundance. However, IDFG will maintain a minimum of 20 to 30 wolves annually in the Lolo Zone for a period of 5 years.

The minimum number of wolves will be determined from observation and enumeration of packs with radio marks and observations of unmarked packs and individual wolves during wolf tracking surveys or during removal efforts. Minimum wolf abundance will be determined annually throughout the control and post-control periods. Wolves determined to be in the Lolo Zone may include any pack members or transients that occur within the Lolo Zone at any time.

Wolf removal will be accomplished by the Idaho Department of Fish and Game and other approved agents of the state. Wolves that inhabit the Lolo Zone will be targeted for removal. Removal will be accomplished using legal means as approved by the USFWS and currently used under provisions of the 10(j) rule. The goal of the removal will be to reduce pack sizes and to remove entire wolf packs where possible. The primary removal effort will occur during winter. Wolf carcasses will be recovered from the field and processed for collection of biological data. Hides and skulls will be used for educational purposes.

The effect of wolf removal in the Lolo zone will be monitored annually. It is anticipated that this adaptive removal strategy will result in improved elk survival and abundance. However examples of wolf control efforts in Alaska and Canada have shown that 5 years may be too short a time period to have substantial growth in ungulate populations (National Research Council 1997). After 5 years, IDFG will conduct a comprehensive assessment of the removal effort and provide recommendations for future management actions.

6) How ungulate population response to wolf removal will be measured and control actions adjusted for effectiveness.

The objective of wolf removal is to improve elk survival to the extent that the cow abundance grows toward the objectives. It is doubtful that cow and calf survival will be improved sufficiently to achieve objectives in 5 years.

Important metrics used to judge effectiveness of wolf removal will be calf survival during mid-December to June 1, and annual cow survival. IDFG will maintain radio-collard samples of adult cow elk and 6-month-old calf elk to mimic previous efforts. In addition, the current research effort will maintain samples of 20 calf elk, 20 cow elk, and 20 bull elk with GPS radio collars. Overall zone survival and cause-specific mortality rates post removal will be compared to pre-removal rates to evaluate changes in annual survival and cause specific mortality.

The effectiveness of this effort will also be evaluated by monitoring changes in elk abundance, trends in abundance, and mid-winter recruitment rates, measured with aerial surveys, using the sightability approach (Unsworth et al. 1994). A zone-wide elk sightability survey was conducted during 2010, and will be conducted in 2013, and finally following the last year of removal in 2015 (assuming the removal effort commences in 2010). The 2010 survey was conducted prior to, or during the first removal and would represent pre-treatment abundance. Sampling intensity of surveys will be increased to allow detection of smaller population changes. In addition, elk and moose sightability surveys were conducted within the research study area in GMU 10 (Pauley et al. 2007) in 2009, and subsequently, will be conducted during all years that zone-wide surveys are not conducted.

The primary objective of the current research effort is to develop a predictive model of wolf-caused mortality rates of moose and elk (Pauley et al. 2007). Wolf presence relative to prey abundance (e.g. wolf-days/elk, wolf-days/moose) will be the primary explanatory variable. Other covariates will include alternate prey abundance, season, winter weather severity, growing season precipitation, animal age/sex, etc. This work will be conducted on two study areas, one of which includes a portion of GMU 10. The findings will provide additional evidence on the effectiveness of wolf removal.

7) Demonstration that attempts were and are being made to address other identified major causes of ungulate herd or population declines or of State or Tribal government commitment to implement possible remedies or conservation measures in addition to wolf removal.

<u>Changes in Elk Hunting Seasons and Harvest Strategies</u>

The first major changes in hunting seasons to reduce bull elk harvest were implemented in 1992. Prior to 1992, the game management units in the Clearwater Region were open to hunting by all regular season tag holders. Beginning in 1992, hunters were required to choose to hunt in either the less accessible Mountain units or in the remaining, more accessible units. In the Clearwater Region, GMUs 10 and 12 were managed in the Mountain Group. This season structure change was implemented to reduce hunter densities. In addition, the opening day of rifle hunting season in GMUs 10 and 12 were moved back to October 10 to move the rifle season out of the rut. These changes reduced general hunt bull harvest within the Mountain Group by 45% between 1992 and 1993. Harvest decreased from 2,037 bulls in 1992 to 1,116 in 1993 and the number of hunters from 8,944 to 5,093 (-43%) while hunter success remained stable (Kuck 1994).

The next major change in season structure came in 1998 with a new elk management plan. A zone system with an A-tag and B-tag structure was implemented in the 1998 hunting season. This grouped GMU’s 10 and 12 in the Lolo Zone. In the Lolo Zone, the A-tag was an early archery season for any elk August 30 to September 30 with unlimited numbers available. The B-tag was an any-weapon hunt for an antlered elk from October 10 to November 3. B-tag numbers were capped at 1,600, which represented a 50% reduction in rifle season bull elk hunters. With the implementation of the zone system in 1998 the controlled hunts for cows were eliminated in GMU’s 10 and 12. It should be noted here that antlerless harvest in the Lolo Zone under the A-tag has been minimal. It has varied between 2 and 20 animals, averaging 7.5 antlerless elk/year, and was eliminated in 2006. Outside of this source, the only remaining cow harvest would be Nez Perce Tribe’s harvest under treaty rights. No documentation exists to estimate this harvest.

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Additionally, an unknown (albeit insignificant) number of antlerless elk potentially are harvested illegally.

The net effect of these season changes and declining elk numbers in GMU 10 has been a decline from 50,334 (1988) hunter days to 5,857 (2009) and a change in harvest from 1,589 bulls to 99. Current hunter days represent only 12% of the 1988 hunter days, and current bull elk harvest is 6% of the 1988 bull harvest. GMU 12 had a peak of 14,757 hunter days that has declined to 3,068 (-79%). Harvest in GMU 12 has declined from 480 bulls to 56 (-88%).

Changes in Black Bear and Mountain Lion Seasons to Address Low Calf Survival

The Lolo Zone has a history of liberal bear and mountain lion seasons. These include no quotas for female mountain lion, and for bears, allowing the use of dogs and baiting. In the mid-1990s season lengths were increased providing longer take seasons.

Beginning in the fall of 1999 a series of changes to bear and mountain lion seasons was implemented. Changes were made as part of the research design (for a more detailed description see Zager and White 2003). Seasons were incrementally liberalized in GMU 10 and 12 as follows: a portion of GMU 12 was split out and a 2 bear and 2 mountain lion bag limit was established. In the fall of 2000 a portion of GMU 10 was also split out where bag limits were liberalized and added the 2 bear, 2 mountain lion bag limits. Concurrent with these liberalizations, tag prices were reduced and the allowed quota on nonresident hound permits was increased. Additionally, outfitters were encouraged to increase harvest of black bears and mountain lions and allow overlap by neighboring outfitters if an outfitter was not going to guide for bears or lions. The use of electronic calls for mountain lions was also approved. By 2003 all of GMU 10 and 12 had the increased bag limits for bears and mountain lions.

These changes resulted in a doubling of black bear harvest in 1998, and black bear harvest has remained at high levels in recent years. The liberal black bear season framework remains in place to date. Mountain lion harvest does not show the same kind of increase and is instead, characterized by an initial increase, particularly in GMU 12, and then a declining trend in harvest post 2000. This is more likely a population response due to a declining prey for the obligate predator rather than a response in season changes. Alternate prey, primarily whitetail and mule deer, are present in these GMU’s but are found at relatively low densities.

Efforts to Improve Elk Habitat

Nearly all of GMU’s 10 and 12 is in Federal ownership, predominately United States Forest Service (USFS). GMU 10 is 1,179 square miles and ownership is 95% USFS, 2% State, and 3% private timber company land. GMU 12 is 1,176 square miles and the USFS owns 95% of which 27% of that is wilderness and 5% private timber company lands.

These areas traditionally had high levels of disturbance. Much of these two GMUs burned in intense wildfires in the early 1900s. Also, in the early 1900’s blister rust was introduced and decimated western white pine stands, once one of the dominant species. Subsequent fire suppression has eliminated much of the natural disturbance once part of the system. This has created a landscape that is dominated by mid-succession forest lacking early seral stages.

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Historically 35% to 45% of the landscape was early seral stage compare with 14% currently (USDA Forest Service 1999). Much of recent disturbance in these areas has come in the form of logging (which peaked in the 1970s and 1980s and has since declined to low levels) rather than wildfire.

Most of IDFG's habitat management efforts are focused on collaboration with the U.S. Forest Service. The focus has been to increase fire frequency through prescribed fire and more liberal "let burn" policies. IDFG has also actively encouraged efforts to control noxious weeds and efforts to close roads to improve elk habitat effectiveness and harvest vulnerability.

By the late 1990s, elk populations in the Clearwater backcountry had significantly declined. In response to this decline the Clearwater Basin Elk Habitat Initiative (CEI) was formed in 1998. The primary objective of CEI was to develop and implement a plan to help recover the elk population and elk habitat in the Clearwater Basin through a coalition of partners. IDFG actively participated in CEI, recognizing the direct relationship between forest management (fire, timber harvest, road closures, and noxious weeds) and elk habitat productivity. One of the first products of this was the joint USFS/IDFG effort that generated the North Fork Big Game Habitat Restoration on a Watershed Scale (USDA Forest Service 1999). This was a comprehensive analysis of 21 watersheds, covering 840,000 acres of the Lolo Zone. Habitat needs for elk and other species, and existing habitat conditions, were evaluated and recommendations to address many of the concerns were made. Recommendations included the need to bring large scale disturbance (managed wildfire, prescribed burning, and timber harvest) back to the landscape, the need to control noxious weeds, and the need to obliterate problem roads no longer needed for access.

The first major restoration project generated out of this evaluation and collaboration was Middle-Black project. The goal of this project was to disturb 11,000 acres in the Middle and Upper North Fork watersheds of the Clearwater River. This project included 5,930 acres of prescribed burning, 2,130 acres of shrub slashing, 640 acres of timber harvest, decommissioning 71 miles logging roads and skid trails, stabilization of 59 miles of intermittent use roads, and 2,300 acres of weed control.

By 2002 the lack of progress toward accomplishment of goals identified in the Middle-Black project resulted in an Elk Summit sponsored by Idaho Senator Mike Crapo. Held in Lewiston, Idaho January 25, 2003, the Elk Summit included speakers who described the complex range of historical and current influences that affect elk populations and management in the Clearwater Basin and a panel of conservation leaders that shared their perspectives, knowledge, and concerns on local elk-related issues. During the meeting and from subsequent written comments, Senator Crapo obtained support for a future collaborative effort to address ways to accomplish identified objectives and increase elk numbers.

During spring 2003, Senator Crapo invited representatives from stakeholder groups that expressed interest in elk management issues in the Clearwater Region to participate in an Elk Collaborative. The goal of the Elk Collaborative was to provide a broad-based forum to develop consensus-based recommendations to recover elk in the Clearwater Basin backcountry. Delegates represented 15 stakeholder organizations (Back Country Horsemen, Wolf Education &

Research Center, Public Land Access Year Around, The Wilderness Society, Clearwater Research Coalition, Great Burn Study Group, Clearwater Elk Recovery Team, Nez Perce Tribe, Three Rivers Timber, Inc., Idaho Outfitters & Guides, Idaho Conservation League, Trout Unlimited, Concerned Sportsmen of Idaho, Clearwater County Commissioners, Avery Area Property Owners Association). Representatives from Idaho Department of Fish and Game participated in these meetings as non-voting technical advisors, as did representatives from the U.S. Forest Service.

Fifty-eight consensus recommendations were developed during 15 meetings held between April 2003 and April 2004. IDFG staff subsequently reviewed the recommendations, identified those that required action on the part of the department, and developed responses to address them. This information was presented to the IDFG Commission at their November 2004 meeting in Orofino at which time the commission voted to endorse the proposed IDFG approach to the recommendations.

Currently, The Clearwater National Forest is working on plans to implement many of the recommendations and recently entered into an agreement with Rocky Mountain Elk Foundation that will provide up to a million dollars to help with prescribed burning. Much of the prescribed fire proposed in the Middle-Black Project has been accomplished. The remainder is scheduled for completion during 2010. In addition, the U.S. Forest Service initiated a substantial effort to ignite prescribed fires in many areas of the North Fork Drainage including Weitas Creek, Toboggan Ridge, Pollock Ridge, and Long Ridge. Through 2008, 17,500 acres have been burned in those areas. Another 59,500 acres are scheduled for prescribed fire over the next 3 to 4 years and additional burn areas will likely be added in the near future.

EFFECT ON STATEWIDE WOLF ABUNDANCE AND WOLF RECOVERY

The 2008 modified 10(j) rule states that the USFWS "*must determine that such actions* (wolf removal) *will not contribute to reducing the wolf population in the State below 20 breeding pairs and 200 wolves*".

At the end of December 2009, there was a minimum estimate of 835 wolves in 94 packs and 49 documented breeding pairs in Idaho (Mack et al. 2010). Furthermore, as the Idaho wolf population continues to expand, the number of wolves observed and the number of documented breeding pairs continue to increase annually (Mack et al. 2010). Of the minimum estimate of 835 wolves at the end of 2009, > 750 would not be exposed to the proposed removal. Of the 49 breeding pairs documented present at the end of 2009, more than 40 would not be exposed to removal. The proposed wolf removal in the Lolo Zone is limited to one of 29 Elk Management Zones in Idaho. This selective and localized wolf removal effort will likely improve elk survival in a very important Elk Management Zone and will not reduce Idaho's wolf population below 20 breeding pairs and 200 wolves.

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Table 1. Estimated abundance, with 90% bounds, of elk during winter (Dec-Feb) in GMU 10, Idaho.

Year	Total Elk	Cows	Bulls	Calves	Bulls :100 Cows	Calves :100 Cows
1992						
Number:	7,760	5,695	755	1,283	13.2	22.5
90% Bound:	± 1,329	± 942	± 251	± 286	± 4.9	± 6.1
1994						
Number:	9,729	7,486	1,107	1,070	14.8	14.3
90% Bound:	± 1,703	± 1,311	± 296	± 235	± 5.2	± 4.2
1998						
Number:	5,079	4,469	318	252	7.1	5.7
90% Bound:	± 812	± 749	± 74	± 54	± 1.8	± 1.4
1999						
Number:	Age Composition Survey					10.9
90% Bound:						± 3.9
2002						
Number:	Age Composition Survey					14.9
90% Bound:						± 4.8
2003						
Number:	2,643	1,832	419	371	22.9	20.3
90% Bound:	± 455	± 369	± 117	± 76	± 9.4	± 5.4
2004						
Number:	Age Composition Survey					25.7
90% Bound:						± 2.8
2005						
Number:	Age Composition Survey					23.4
90% Bound:						± 2.6
2006						
Number:	3,452	2,276	504	669	22.1	29.4
90% Bound:	± 774	± 512	± 117	± 177	± 6.3	± 9.9
2010						
Number:	1,473	824	461	144	55.9	17.4
90% Bound:	± 290	± 211	± 143	± 45	±27.8	± 5.9

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Table 2. Estimated abundance, with 90% bounds, of elk during winter (Dec-Feb) in GMU 12, Idaho.

Year	Total Elk	Cows	Bulls	Calves	Bulls :100 Cows	Calves :100 Cows
1992						
Number:	3,452	2,515	549	382	21.8	15.2
90% Bound:	± 422	± 332	± 129	± 56	± 5.5	± 2.4
1994						
Number:	3,315	2,414	446	325	18.5	13.5
90% Bound:	± 416	± 334	± 110	± 99	± 4.5	± 4.6
1995						
Number:	3,832	2,754	465	599	16.9	21.8
90% Bound:	± 425	± 322	± 98	± 82	± 4.2	± 3.6
1997						
Number:	2,667	2,060	425	181	20.6	8.8
90% Bound:	± 406	± 286	± 121	± 33	± 8.0	± 1.9
1999						
Number:	Age Composition Survey					17.1
90% Bound:						± 8.2
2002						
Number:	2,048	1,281	422	343	33.0	26.8
90% Bound:	± 330	± 183	± 122	± 75	± 11.4	± 6.6
2003						
Number:	Age Composition Survey					30.4
90% Bound:						± 7.9
2004						
Number:	Age Composition Survey					28.1
90% Bound:						± 2.8
2005						
Number:	Age Composition Survey					13.9
90% Bound:						± 3.8
2006						
Number:	1,658	978	475	196	48.6	20.1
90% Bound:	± 371	± 203	± 126	± 101	± 12.5	± 11.9
2010						
Number:	705	534	133	38	25.1	6.9
90% Bound:	± 241	± 210	± 49	± 19	± 10.5	± 4.5

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Table 3. Survival rates of cow and calf elk radio collared in the Lolo Zone, Idaho, 2002-2009.

	Cow Elk[a]			Calf Elk[b]		
Year	Survival Rate[c]	Standard Error	*n*[d]	Survival Rate	Standard Error	*n*
2002	0.89	0.07	18			
2003	0.75	0.11	16			
2004	0.83	0.05	56			
2005	0.82	0.05	74	0.73	0.08	30
2006	0.72	0.05	89	0.73	0.08	30
2007	0.71	0.05	74			
2008	0.77	0.06	58	0.09	0.09	11
2009	0.88	0.05	55	0.60	0.13	15

[a] Cow elk include female elk ≥1 year of age. Survival rates were calculated for a 1 year time period beginning on April 1 of the year indicated through March 31 of the following year.
[b] Calf elk include male and female elk <1 year of age. Survival rates were calculated for the time period beginning at capture during winter of the year indicated, until June 1. Calves were captured in December 2005 and 2006, for the 2006 and 2007 field seasons, respectively. During 2009 and 2010, calves were captured in January.
[c] Survival rates were calculated following the Kaplan-Meier procedure (Pollock et al. 1989). The calculations include all deaths except those associated with capture.
[d] Total number of radio-collared cow elk monitored that year, including surviving animals from the previous year. Therefore, "*n*" exceeds the number of unique radio-collared cow elk.

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Table 4. Causes of deaths of radio-collared cow and calf elk in the Lolo Zone, Idaho, 2005-2009.

	Predation			Causes Unrelated to Predation			Cause Unknown
	Wolf	Cougar	Unknown Predator[a]	Accidents	Breech Birth	Malnutrition	
Cows	37	5	4	2	1	1	18
Calves	21	5	2	1	0	1	3

[a] "Unknown predator" implies the deaths were caused by predation, but the species of predator could not be determined.

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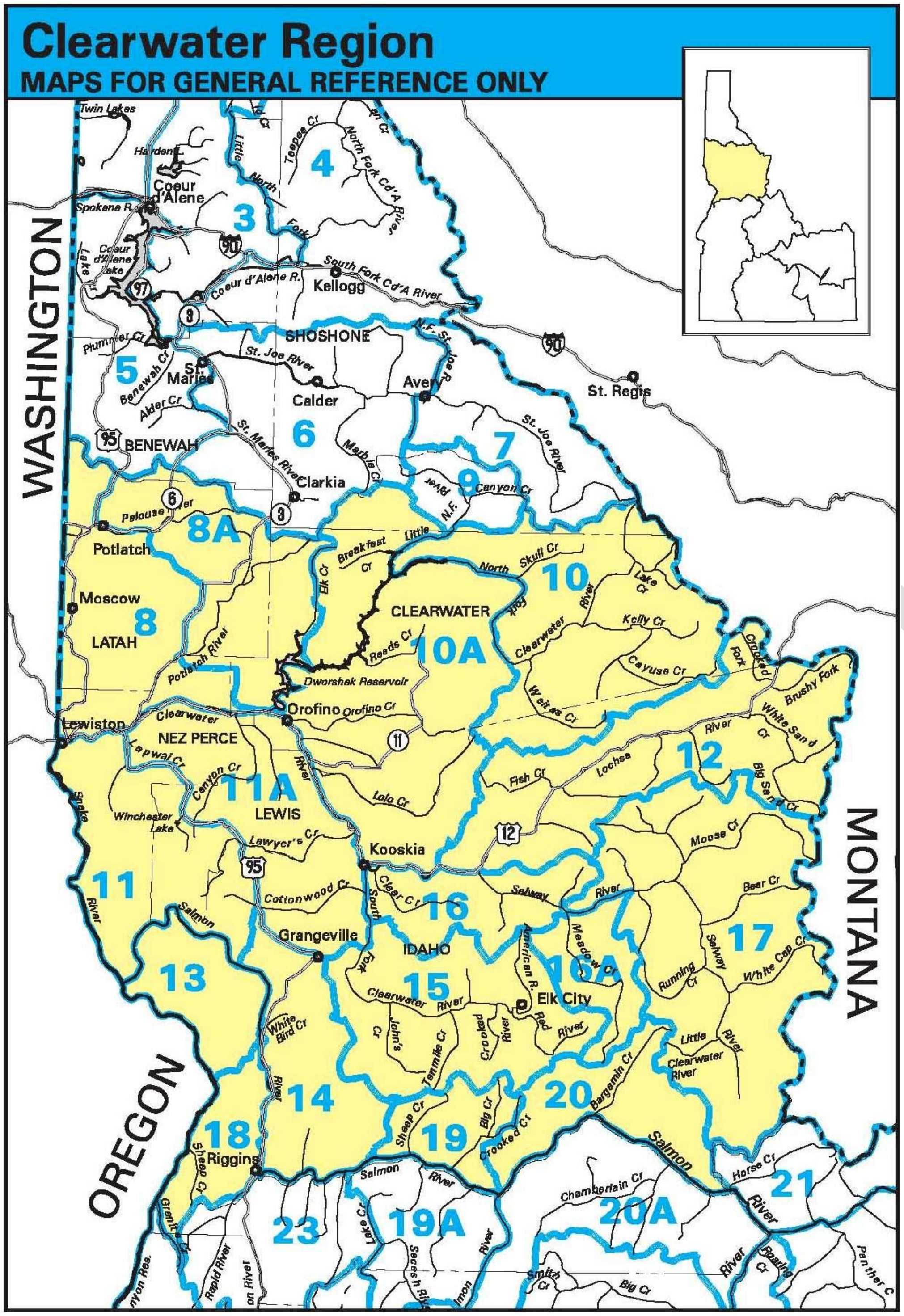

Figure 1. Location of GMU's 10 and 12 in Idaho.